AGRICULTURAL Research

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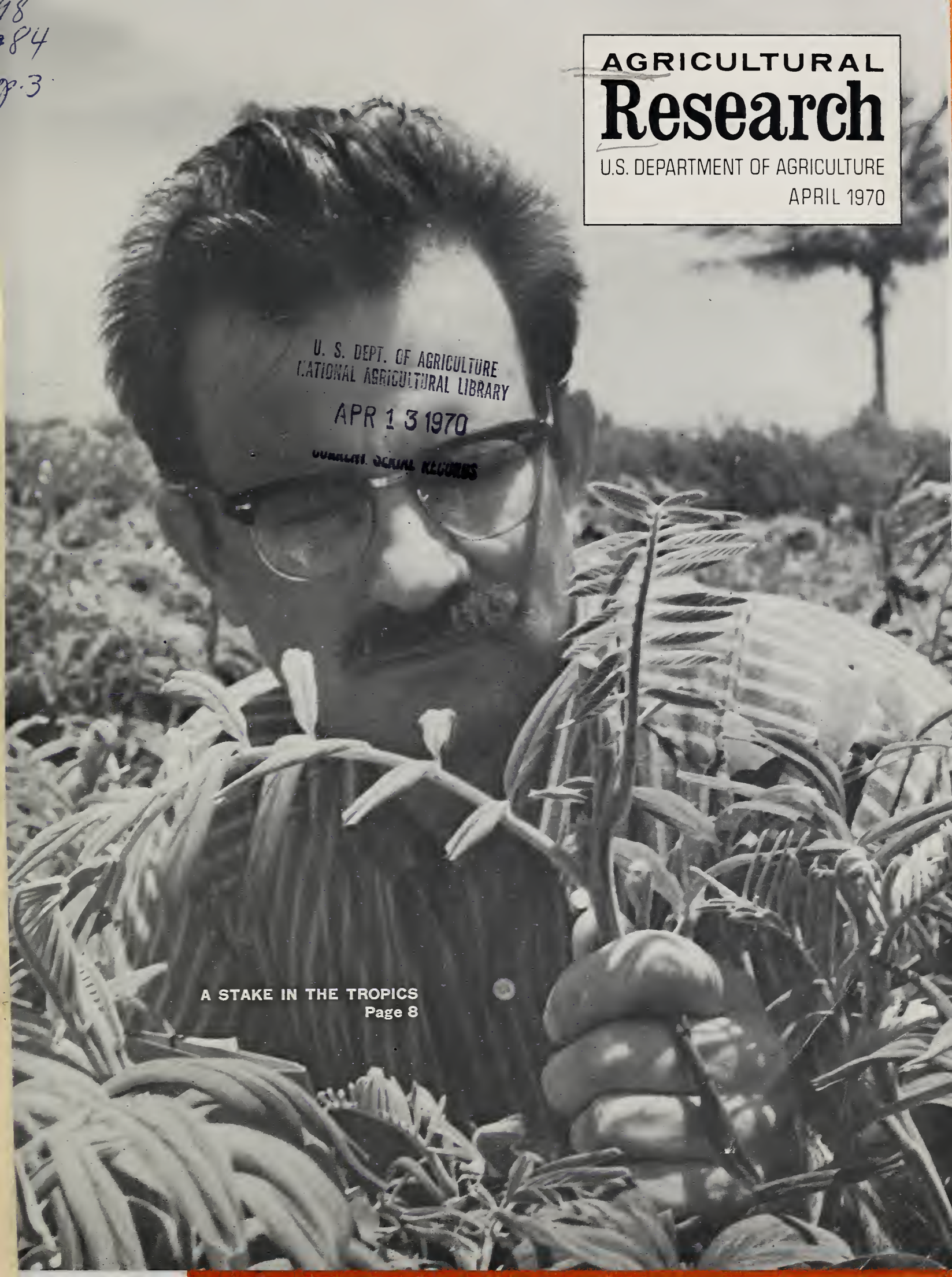

AGRICULTURAL
Research

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Embattled Desert Patriarchs

The saguaro cactus, whose bizarre candelabra silhouette symbolizes the Sonoran Desert, is in trouble: It is not repopulating much of its range.

Even to a casual observer the saguaro is a marvel of evolutionary engineering, adapted to flourish in its harsh environment. Its columns are fluted with accordion-like pleats that expand to store up to a ton of water which the plant's roots quickly seize from the desert's meager rainfall. Some of these botanical giants tower 50 feet, weigh 10 tons, and live for 200 years. Clearly, they dominate the flow of life and energy around them.

What, then, is impairing the saguaro's ability to renew itself? When the saguaro's plight was recognized early in this century, various causes were advanced: grazing, ground squirrels, frost, and disease. For a time the old Desert Laboratory probed the riddle, then for decades science largely ignored the saguaro. The few efforts made thereafter were hampered by scant knowledge of the plant's life history.

To close this gap, University of Arizona and Federal scientists initiated a series of lab and desert studies about a dozen years ago. Two ARS scientists, one a top expert on pollination, joined in running cage tests on whether pollination played a role in the saguaro's decline. It was ruled out as a limiting factor. Indeed, in probably the first experiments on the pollinating capabilities of bats and birds, the scientists established that these two animals, as well as bees, can cross-pollinate saguaro blooms. An ARS scientist, in work on the environmental needs of seedlings, helped prove that without shade, every little saguaro is doomed. This finding relates to climatic change, now considered as mainly responsible for the dwindling saguaro stands. Precipitation has been decreasing about an inch every 30 years, an environmental change that has been killing off the acacia and palo verdes plants in whose shadows the saguaro normally took root.

Slowly the saguaro yields its secrets. As knowledge is amassed, science may yet tap nature's latent power of renewal and save these desert patriarchs. Whatever the outcome, this quest reaffirms how fragile are the natural communities of which we are a part—basic knowledge that must underlie today's efforts to restore our environment.

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

farm nitrates

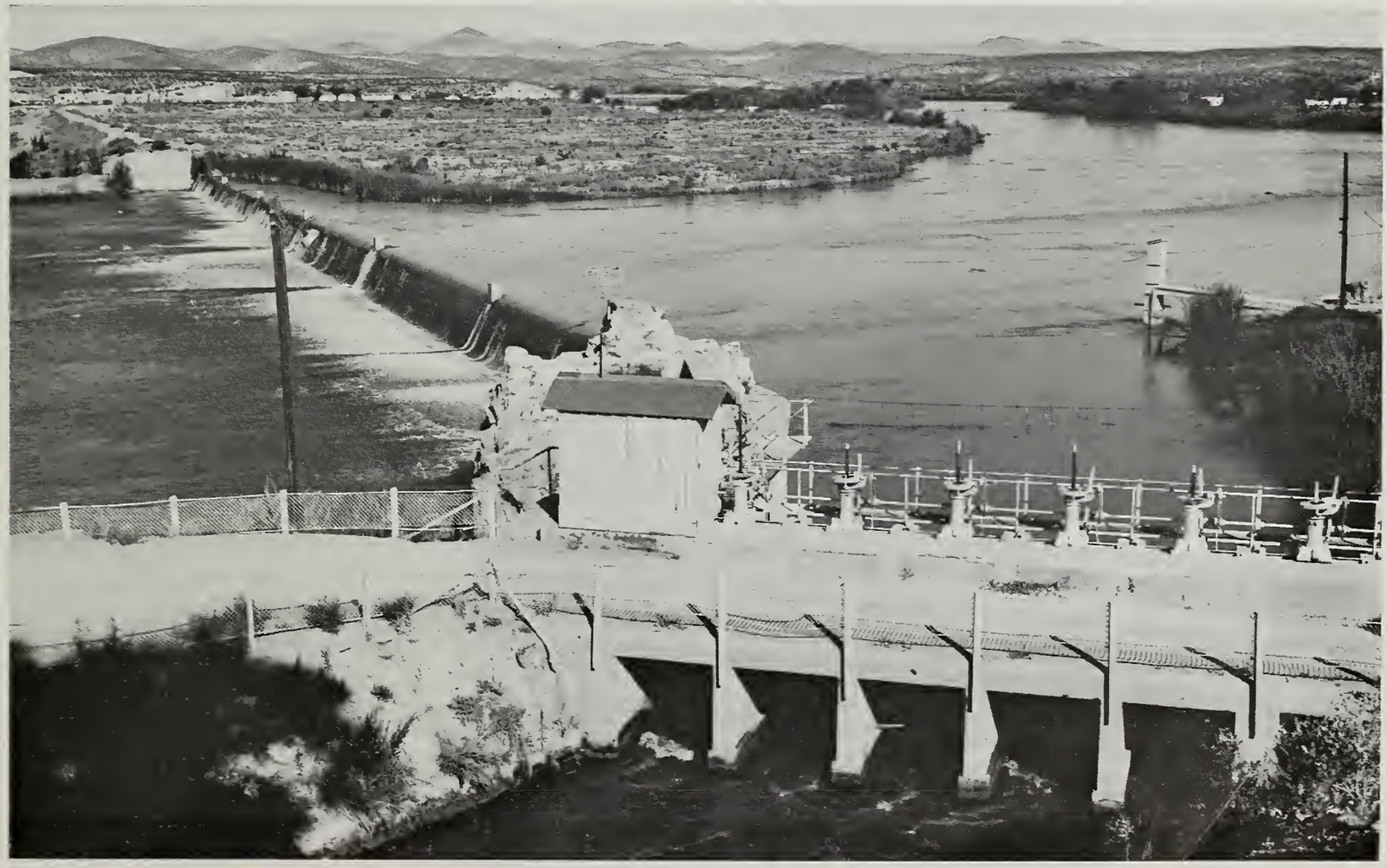
. . . no menace to the Rio Grande

IT ISN'T TRUE that ol' man river "don't say nuthin." Rivers can tell a lot if the right records are kept.

Take the upper Rio Grande—it has a lot to say about the serious questions being raised concerning pollution of streams by nitrate-nitrogen (NO_3-N) leached from neighboring irrigated lands.

As part of a 30-year study of salt-balance conditions in three irrigated areas along the river, scientists obtained information about NO_3-N content over a period when nitrogen fertilizer increased from almost nothing to a high level. They found that the overall NO_3-N concentration of the river did not increase, indicating no significant stream pollution by NO_3-N from nitrogen fertilizer.

The three irrigated areas are the Rincon Valley (17,000 acres), far-



At the upper end of the Mesilla Valley, the middle area of the tests, water is diverted from the river by the Leasburg Diversion Dam (Bureau of Reclamation photo) (PN–1865).

ther downstream the Mesilla Valley (80,000 acres), and below that the El Paso Valley (52,000 acres). Water for irrigation is taken from the Rio Grande at various diversion dams. The drainage water returns to the river above the point where water is withdrawn for the next downstream irrigated area.

ARS scientists in a joint study with the U.S. Bureau of Reclamation and the International Boundary and Water Commission measured the flow and NO_3-N content of the irrigation water and of the river at Percha, Leasburg, and American Dams and at the El Paso-Hudspeth County line, which lies below all of the areas.

At each monitoring station, the river's average annual flow lessened with time while the NO_3-N concentration remained stable or decreased, except during the last 10-year period at the El Paso-Hudspeth County line. There, with a very low flow, NO_3-N increased slightly. Highest concentration of NO_3-N recorded at that spot—the highest of all the monitoring stations—was 0.68 parts per million (ppm). Health officials say that up to 10.0 ppm NO_3-N is safe in water for human consumption.

While the data on fertilizer use is sketchy, annual amounts of nitrogen fertilizer applied in the three irrigated area climbed sharply during the 30-year period. State consumption statistics indicated increases on the order of 35- to 100-fold.

ARS soil chemist C. A. Bower and retired soil scientist L. V. Wilcox of the U.S Salinity Laboratory at Riverside, Calif., made the study. They say that the greatly increased use of nitrogen fertilizer in the Rincon and Mesilla Valleys has not increased the NO_3-N load of the Upper Rio Grande.

As for the slight rise in NO_3-N at the El Paso-Hudspeth County line, greatly increased fertilizer use may have contributed. But most of the rise can be accounted for by the markedly decreased amount of irrigation water returning to the river as drainage water. Moreover, the drainage includes treated sewage water from the city of El Paso, and this may contribute to the increase in NO_3-N concentration. Even so, this is less than that observed for water diverted to Rincon Valley when nitrogen fertilizer use was almost nothing.

A natural source of NO_3-N or mineralizing organic nitrogen appears to explain the relatively high concentration of NO_3-N in drainage water from the Rincon Valley. Recorded levels were 2.31 ppm the first 10 years, 2.84 ppm the second, and 1.61 ppm the last 10 years of the study. In the first 10 years when little fertilizer was used there, the NO_3-N concentration in the irrigation water showed 0.15 ppm while the drainage water was showing 2.31. ■

Left: *Fields in the three valleys studied are irrigated by river water. Contribution of rainfall to the drainage water returned to the river is considered negligible (Bureau of Reclamation photo) (PN–1866).* **Right:** *Map shows relationship of the three valleys and the diversion dams. El Paso-Hudspeth County line is at lower right (PN–1857).*

Managing a pesticide

Researchers are taking surface soil samples in the Coshocton studies to analyze the pesticide content (PN–1858).

GOOD CONSERVATION PRACTICES that control erosion and runoff may also substantially reduce water pollution by dieldrin and other organo-chlorine insecticides.

Results of a recent study using data from the Northeast Appalachian Watershed at Coshocton, Ohio, with analysis by ARS soil scientist A. W. Taylor and others at Beltsville, Md., show that:

(1) When an organo-chlorine insecticide is incorporated into the soil by disking and mixing, a large fraction is retained by the soil for long periods of time. Of 5 pounds per acre of dieldrin sprayed on bare soil at Coshocton and disked to a depth of 3 inches, 75 percent of the original quantity was in the soil 2½ years later.

(2) Small amounts are carried off in water when surface runoff is permitted. Soil conservation practices can stop that movement. Dieldrin is so strongly adsorbed by soil particles that water moving *down* into the soil does not carry insecticide with it.

(3) Significant amounts of insecticide can be carried by sediments if erosion occurs, but this, Taylor says, can also be prevented by conservation practices that stop erosion.

(4) The main pathway for loss is by evaporation to the air. The rate decreases rapidly after the first few weeks. When the insecticide is worked into the soil, the rate of loss to the surrounding environment is small.

Results of an elaborate air sampling program confirm that volatilization is the main way by which organochlorine insecticides leave the soil. Taylor says that about 10 percent of the amount applied during the experiments was lost this way the first year. Actual amounts found at any one time are small and detectable only close to the ground. Wind dilutes the amount so much that it cannot be detected more than 15 feet above the crop.

Small amounts (0.7 and 1.0 parts per million) of dieldrin were found on the leaves and outer parts of corn plants. Stalks contained 0.1 ppm and less than 0.02 ppm was found in the cobs and kernels. The total quantity found in the crop was less than 0.5 percent of that applied to the soil.

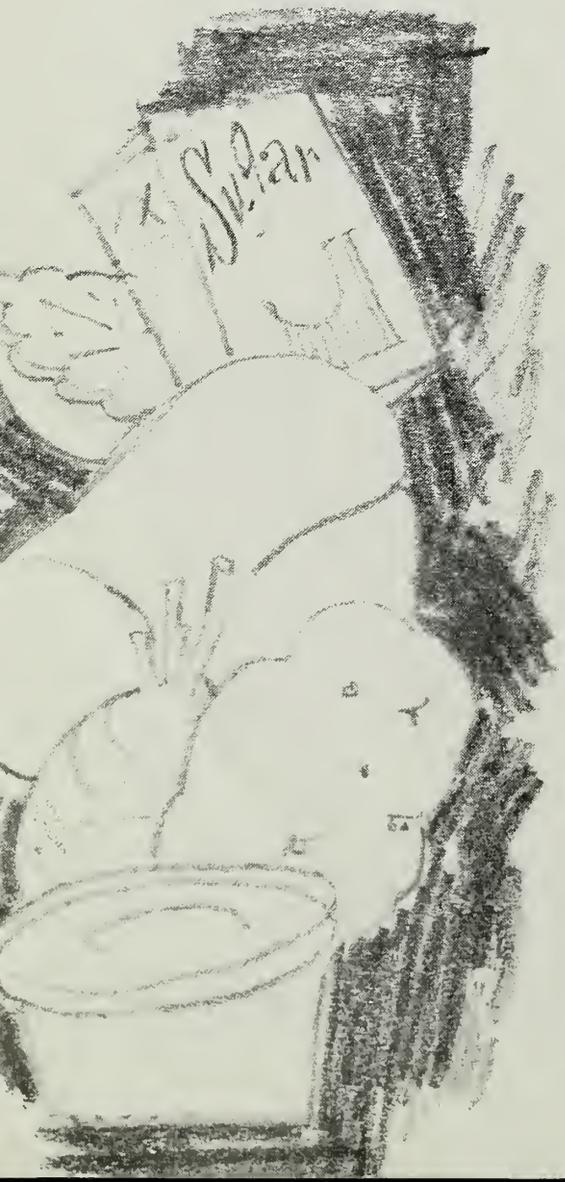
The distribution of dieldrin on the outside of the plants suggests, Taylor says, that the insecticide is not moving up through the roots into the plant but is condensing on the outer parts of the plants from the air.

As for the runoff water, 1968 results show that if water runs off within 2 weeks after application, concentration of dieldrin can be as high as 18 parts per billion; within 2 months the concentration drops to about 5 ppb and then slowly continues downward. The amount of dieldrin lost this way is less than 0.03 percent and can be reduced by good conservation practices. At Coshocton, conditions favorable to runoff were deliberately created to measure dieldrin losses. ■

carbohydrates . . . *part of the cholesterol riddle?*

RECENT ISRAELI WORK with human subjects supports nutrition findings in rats—that carbohydrate-induced fats in blood should be considered as carefully as excess cholesterol in the blood.

Excess lipid (total fat and cholesterol) levels in blood are called hyperlipemias; this condition is associated with arteriosclerosis, cardiovascular disease, and diabetes. A type of hyperlipemia may be due to excess cholesterol. In carbohydrate-induced hyperlipemia, called C-hypertriglyceridemia or C-HG, dietary carbohydrates tend to be converted into excess fat derivatives or triglycerides (TG). Accordingly, in C-HG, the excessive blood lipid levels are measured as TG and cholesterol levels.



To learn more about C-HG, Israeli scientists, working under an ARS-sponsored Public Law 480 grant, investigated dietary effects of carbohydrates on lipid levels in human blood.

In one set of experiments at the Hadassah Medical College, Jerusalem, patients already suffering from hyperlipemia were studied because this condition made them more responsive to dietary changes. The carbohydrates fed the patients were starch, sucrose, and glucose. In all cases, the sucrose and glucose diets caused an increase in TG levels; sucrose, however, induced the highest TG levels.

On the other hand, starch fed either before or after the sucrose and glucose diets caused a lowering of TG levels. During these feedings, total serum cholesterol (TC) generally followed the same pattern as serum TG, but at lower levels and slower rates.

Israeli investigators indicate there is no clear explanation for the different responses of serum lipid levels to the feeding of starch, a complex carbohydrate, as opposed to the feeding of simple carbohydrates such as sucrose and glucose. One suggestion is that starch absorption is slower whereas the simpler sugars are absorbed more rapidly.

Another possibility is that starch breaks down directly into glucose whereas the breakdown products of sucrose include a fruit sugar called fructose.

In pursuing the challenge indicated by the sucrose and suspected fructose effect on TG levels, the Israelis compared patients with C-HG to four normal controls.

Considerable variation in serum lipid levels was found during this series of experiments. In one patient, for example, the serum TG ranged from 370 to 845 milligram-percent (milligrams of TG in 100 milliliters of blood). Normal TG level is less than 180 milligram-percent.

When fed fructose, the TG in the same patient increased to 1,980 milligram-percent. When the patient was fed glucose and sucrose during a previous experiment, the TG values increased above the levels observed during starch feeding, but the top levels of glucose and sucrose were much lower than those during fructose feeding.

In two normal subjects and in two patients with mild C-HG, no change in TG was observed when fructose was substituted for starch. In all four normal subjects, neither fructose nor sucrose caused any unusual increase in cholesterol levels.

The Israelis point out that variability of serum lipid responses to the interchange of simple dietary sugars with starch can be a significant factor in carbohydrate metabolism. This variability suggests that only in certain individuals are there such marked changes in TG and cholesterol levels as to indicate a derangement of carbohydrate and lipid metabolism.

The Israeli work has added to mounting evidence that in some cases of C-HG, starch reduces both serum TG and cholesterol levels. Moreover, in these C-HG cases, the hyperlipemia is, at least in part, caused by the metabolic process occurring when fructose is released from sucrose.

Further studies are in progress to learn whether C-HG induced by fructose depends upon the pre-established TG levels of a person's everyday diet.

Mildred Adams, Beltsville, Md., was the ARS sponsoring scientist. Project leader in Israel was S. H. Blondheim. ■

the Helix
new twist on food processing

FROM A DISTANCE, a rotating hydrostatic helix looks like a drum with tubing coiled around it. Up close, it still looks like a drum with tubing coiled around it.

For all its apparent simplicity, the experimental device at the ARS Western utilization research laboratory, Albany, Calif., has attracted wide attention from food processors and manufacturers of food containers and processing machinery. They see it as the forerunner of equipment with important applications in food processing. Its design and development are the work of engineers D. F. Farkas, M. E. Lazar, and W. C. Rockwell.

Helical pump is a shorter name for the device. And the terms *hydrostatic* and *helical* explain it and what it does. Hydrostatic has to do with pressures created or transmitted by liquid—the pressure a column of liquid exerts against the bottom of a vessel, for example. Helical describes a spiral form such as a coil.

One way to grasp the principle of the helical pump is to imagine a long upright tube filled with a stack of 10 short columns, or "legs," of liquid separated by air spaces. The hydrostatic pressures exerted by the liquid legs are additive—if each leg exerted one pound of hydrostatic pressure, the pressure at the bottom of the tube would be 10 pounds. This tube, if wound around a drum, becomes a helical pump that builds up hydrostatic pressure when rotated around a horizontal axis.

In operation, the intake turn is alternately filled with equal volumes of liquid and air. With each rotation of the device, the liquid and air is advanced one turn. The process is continued so that every coil has a liquid leg. Pressure from the legs is additive. For example, in a coil that has 10 turns, each with a liquid leg 3 feet long, the hydrostatic pressure at the discharge, the last turn, equals that created by a column of water 30 feet high. Objects can be conveyed through the coil as the liquid is advancing one turn with each rotation.

Farkas observes movement of vials simulating glass jars of food emerging from a model of the helical pump in the Western laboratory's pilot plant (PN–1859).

Several applications are foreseen. The pump could be modified, for example, to simplify the moving of food into and out of huge pressure cookers. At present, racks of food are typically wheeled into a room-sized cooker, doors are then sealed, and heat and pressure built up. These steps are reversed when cooking is complete. A helical pump, engineers think, could serve as a nonstop conveyor to pump food into a chamber held at constant heat and pressure. Pressure in the last turn would equal that in the cooker. A second helical pump with de-escalating pressures would pump food out of the pressure cooker.

Another possibility is to use the helix itself as a pressure cooker. Engineers see several advantages over present hydrostatic cookers—essentially towers of hot water through which chain conveyors run. At the bottom of the towers, cans are under pressure exerted by the high column of water. The helical pump, however, would do away with water towers 30 or more feet high and elaborate conveyor systems, thus simplifying the process and saving space.

Furthermore, a helical pump may be able to pressure-cook and convey unpackaged foods or foods in plastic pouches—operations for which efficient equipment is not available.

Still another application would be to use the pump to convey food into and out of vacuum chambers continuously. The vacuum-creating process would be essentially a reversal of the pressure-buildup process. ■

a stake in the tropics

THE YEAR-ROUND warm temperatures and sunny weather of Puerto Rico offer a valuable climate for plant research, and in exploiting it the Federal Experiment Station in Mayaguez provides benefits that reach beyond the island.

The only ARS crops facility in the tropics, FESPR is devoted primarily to studies of exotic plants, especially those of economic importance to the U.S. mainland, and special crops of interest and value to island agriculture. Some projects—increasing and evaluating cantaloup and tomato breeding lines, for example, are operated to benefit both Puerto Rican and mainland agriculture. In these projects, the station is extremely valuable because plantings can be routinely made in every season.

The station is also conducting research to ease hunger in underdeveloped tropical countries. Two programs, partially supported by the Agency for International Development, are underway on tropical root crops and on beans and other edible legumes. Germ plasm is being evaluated for sources of improved quality, nutritional value, and insect and disease resistance.

One of the station's functions is to maintain species not readily available—black pepper and vanilla cultivars, for example. A large number of cocoa cultivars are held in a germ plasm collection to provide authentic, disease-free propagating material for breeders and other researchers.

The station's arboretum, embracing some 2,500 exotic tropical species, is considered one of the largest and best documented collections in the Western Hemisphere. It attracts botanists, horticulturists, and other visitors from tropical countries.

FESPR is one of USDA's oldest functioning field stations. It was established in 1902 to help improve and diversify island agriculture. The local government authorized the use of 235 acres for the main station at Mayaguez with additional land for field sites in other parts of the island.

Until 1931, when the University of Puerto Rico established its Agricultural Experiment Station, the ARS station was the only institution of its kind in Puerto Rico. The original research program encompassed animal husbandry, entomology, and forestry, as well as crops studies. In the thirties, projects relating solely to insular agriculture were reduced, a broader program of new crops research was developed, and ties with USDA programs on the mainland were expanded.

In its very early years, FESPR bolstered the sugarcane industry—the island's economic backbone. It introduced and developed species resistant to mosaic disease, thus saving the industry from ruin, and produced many new seedlings of the Mayaguez variety now grown extensively. And when white grubs threatened the crop in 1920, station researchers solved the problem by introducing *Bufo marinus L.*, a giant toad that preys upon the grubs. Millions of the toads now inhabit the island. It is estimated that a thousand of them eat as many grubs in about 2 years as crews hand-picked in 5 years.

The station's early introductions of several forage and pasture grasses—elephant, Guatemala, and pangola in particular—became mainstays of the cattle and dairy industries. The grasses are now so common that they are often considered native.

In the early forties, the station introduced several species of beneficial insects which are natural predators of major insect pests. Many of these predators became established and have since been distributed to Florida, Louisiana, and elsewhere.

During World War II, the station adapted sweet corn to tropical conditions, and thousands of pounds of this seed provided an important source of fresh vegetables for U.S. Armed Forces stationed in the tropics.

The station is especially suitable for tropical research because Puerto Rico, a diverse island of mountains and lowlands, incorporates many of the climes found in the tropics. Thus, the station should play an even more important role in the future. ■

Cover: *M. H. Gaskins checks growth of* Tephrosia voglii, *an African legume source of rotenone used to kill "trash fish" in ponds (ST–5298–8).* **Above:** *Newly arrived cocoa clone bud is inserted into rootstock to produce plant for quarantine, then transferral to collection (ST–5297–11).*

Top: *Narciso Almeyda cross-pollinates flower on a cocoa tree to produce hybrid seeds (ST–5297–17).* **Lower left:** *Breaking open hard cocoa pod reveals seeds from which chocolate is manufactured (ST–5294–4).* **Lower right:** *Rodrige Alcorro inspects a vanilla cutting for disease (ST–5294–19).*

Below: *Researcher checks harvested heads from hybrid sorghum plants cut for threshing. Seeds from this harvest will be sent to cooperators in Texas who will evaluate progenies in the summer season. Selections made in Texas will then be returned to Puerto Rico for further breeding work the following winter (ST–5296–5).*

decoding plant disease signals

EXACTLY what virus diseases do to plant tissue and how they do it is coming into sharper focus, pointing the way to solutions for problems of wheat, oats, barley and perhaps other crops subject to virus diseases.

The long-term study conducted by ARS plant pathologist S. G. Jensen at Brookings, S. Dak., may also show what plant characteristics are most closely associated with resistance, providing a potentially valuable aid for screening breeding lines.

At present, a crop's injury by virus cannot be fully assessed until harvest, when yields tell the story. Field tests show that before harvest, some attractive plots yield disappointingly and some poor-looking plots yield more than their appearance would indicate.

Effects of viruses on yields reflect differences found in laboratory studies of diseased and healthy plant tissue. These differences could warn of virus injury much earlier.

By the third week after infection from barley yellow dwarf virus, the photosynthesis (food production in the leaves) of diseased plants falls to only 15 percent of normal. Respiration of these plants increases to 250 percent above normal.

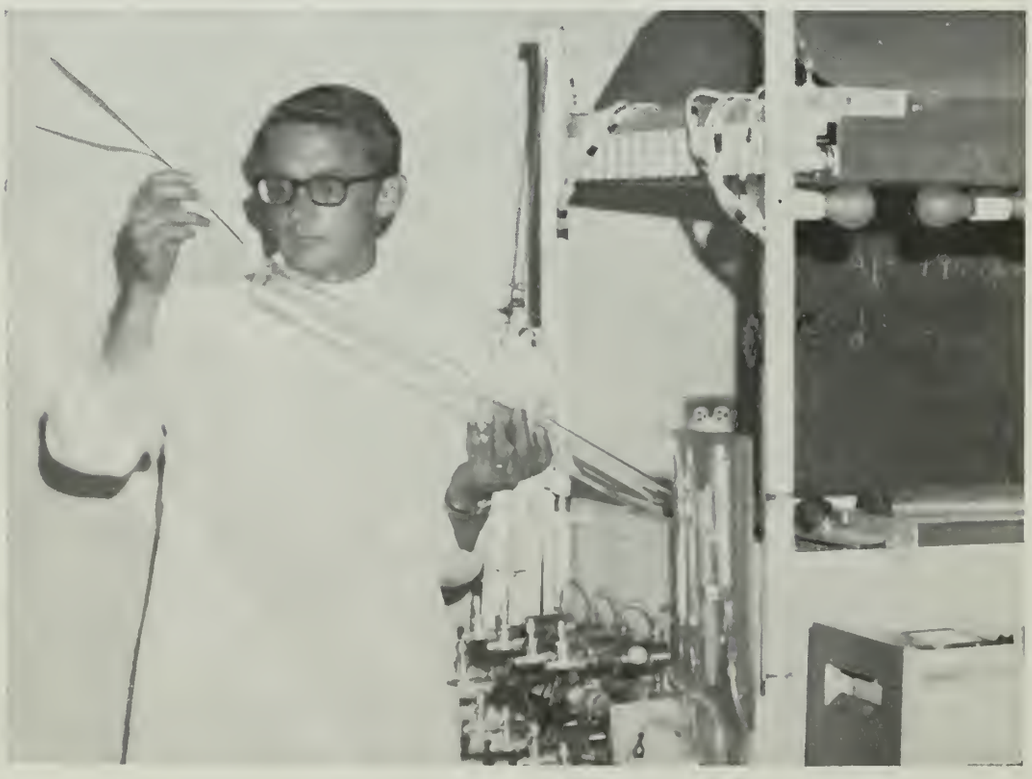
Related studies showed a difference in dry matter composition between tissue from diseased and normal plants. Jensen found seven times more carbohydrate and starch in virus-infected wheat leaves. These accumulations of plant sugars and their precursors are associated with chlorosis—yellowing of leaf and other tissue—and increased respiration.

Closer examination of infected tissue under an electron microscope sheds more light on Jensen's earlier findings: Some cells of phloem tissue, a part of the stem on which disease-spreading aphids feed, were packed solid with virus particles. Virus invasions of a few strategically located phloem cells may thus disrupt transmission of nutrients from leaf to stems, kernels, and roots.

Jensen obtained the same results with 10 varieties of hard red spring wheat. Like other studies, the Brookings experiments not only provide answers but also raise new questions. For example, why is this virus found only in few highly specialized cells when other plant viruses occur in many cells. Is susceptibility or resistance related to the number and type of cells invaded, or does it hinge on the ability of the plant to function in spite of infection? Jensen's findings suggest that the mechanism governing translocation of nutrients by plants may be subject to other influences not yet understood.

Scientists want to find out more about what happens when a virus invades resistant and susceptible plants—and why such differences occur. Then, appropriate chemical, genetic, or other approaches may be brought to bear on the problem.

The South Dakota Agricultural Experiment Station is cooperating in this project. ■



Left: *Jenson loads wheat plant into an instrument for measuring photosynthesis (PN–1860).* **Above:** *Barley yellow dwarf virus has infected and stunted spring wheat at right. (PN–1861).*

CHANGES in a conventional combine can provide lots of TLC—tender loving care—to seed destined for the planter.

Forage seeds and beans need extra care to avoid damage to the germ. Damaged seeds deteriorate faster than undamaged ones and are more susceptible to insects and diseases. Moreover, shortage of labor and the high cost and often short supply of hybrid seed are forcing farmers to move toward precision planting of undamaged, high-germinating seeds to get big yields while holding down costs.

ARS agricultural engineers at Corvallis, Oreg., used the modified combine on crimson clover and threshed 98 percent of the seed with little or no damage. Conventional equipment left 23 percent of the seed unthreshed and 2 percent damaged. The modified machine also worked extremely well on bluegrass, orchardgrass, ryegrass, and on easily damaged green beans.

ARS agricultural engineer J. E. Harmond and co-workers, cooperating with the Oregon Agricultural Experiment Station, made several major changes in the combine. Changes included replacing the conventional threshing cylinder with two rough-surfaced endless belts and exchanging the conventional flat oscillating screens for a vertical rotating screen.

Conventional threshing cylinders operate like an old-fashioned flail—tines and knobs on the cylinder literally beat the seed loose. On the modified cylinder, however, the flat endless belts, running close to each other at different surface speeds, give a gentle threshing action similar to rubbing the seed out between the hands.

The vertical screen solves a gravity-caused problem. On the side of a hill, material piles up on one side or the other of a regular flat screen, leaving much of the screen unused. The vertical screen, operating at a centrifugal force 10 times that of gravity, virtually eliminates this type of problem.

The vertical rotating screen can be seen at left behind front wheel. Seed from it goes into a bag hanging behind the wheel (PN–1862).

the gentle combine

Other modifications include a rubber-covered roller that the incoming crop passes under, helping to crush seedpods to release seeds. The roller also serves as a metering device to prevent bunches of straw from being pulled into the threshing belts.

In operation, the crop passes through the threshing belts and is discharged onto a modified straw walker that shakes the material, sifting out seeds and small particles while the large straw and leaves are moved out of the machine. The seeds and other material fall into a pneumatic separator (blower-type cleaner new to combines) which is adjusted to remove everything lighter than the seed being harvested. From the separator, the material enters a second cleaner where seeds like crimson clover that sometimes remain in the burr are discharged for rethreshing.

The threshed seeds from the second separator are fed directly into the vertical rotating screen that removes any remaining material larger than the seed and discharges clean seed.

Although the modified combine is more thorough and gentler than conventional machines, the research for improvement continues. ■

"a stitch in time . . ." PROTECTING THE HORSE

PREVENTIVE RESEARCH might describe ARS studies of equine viral arteritis, a highly infectious disease of horses.

A potential threat to the rapidly growing horse industry, the disease is relatively new in this country. Only two outbreaks have occurred here since 1953, when the first U.S. case was reported. But the disease often breaks out abroad and was widespread in Europe at the turn of the century.

Researchers at the National Animal Disease Laboratory, Ames, Iowa, were the first to isolate the virus which causes equine viral arteritis. ARS pathologist P. C. Estes at Ames, is now investigating the how and why of these outbreaks.

Estes says that the disease strikes unexpectedly on breeding farms, causing pregnant mares to abort. An abortion "storm" usually ensues and a high percentage of foals are lost. After losing the foal, the mare recovers. Stallions may also be infected and recover. Once recovered, horses appear to have life-long immunity.

Infection spreads rapidly from horse to horse, either by direct contact or through contact with exposed materials or objects. Estes says it is a mystery why horsemen have not seen more of the disease. It is extremely infectious, and scientists have yet to find a horse that is not susceptible. Rarity of the disease, however, is substantiated by the general lack of resistance found in horses.

Although horses infected on the farm recover quickly, those experimentally infected in the laboratory often die. The disease is acute, with death coming about 1 week after inoculation. Infected animals become weak and uncoordinated, go off feed, and run a high temperature. Foals and grown horses have characteristic lesions of internal organs and arteries. Blood clots form in the vessels and body tissues leak fluids, causing the animal's death. In the laboratory, a susceptible horse usually dies of the disease if he is placed in a stall where an infected horse has previously died.

Estes believes the disease to be highly dependent upon the amount of exposure, and horses on farms apparently are not exposed to enough of the virus to cause death. There is no other known host for equine viral arteritis virus. Scientists have been unable to infect guinea pigs and other small laboratory animals.

Because of the nature of the virus, a vaccine is distinctly possible. University of Kentucky scientists are trying to develop a vaccine in case this disease should attack our horses. ■

the cattle-parasite equation

PARASITISM in cattle may be influenced more by stocking rates on pasture than by grazing system.

Cattlemen usually practice rotational rather than continuous grazing to, among other things, reduce the number of internal parasites in cattle. However, ARS microbiologist Honorico Ciordia, with animal scientists D. M. Baird and H. C. McCampbell of the Georgia Agricultural Experiment Station, Experiment, Ga., found that a rotational system of grazing did not reduce the number of parasites if the pasture was overstocked; in fact, the number of worms increased.

The scientists conducted experiments during three seasons of grazing cattle on temporary winter pasture. Hereford steers of similar age, weight, grade, breeding, and degree of parasitism were divided into three groups. Group I steers grazed continuously on the same plot of ground. Group II steers were rotationally grazed at irregular intervals on four plots of ground stocked with the same number of steers per acre as Group I. And Group III was rotationally grazed as in Group II, except that the plot was stocked to near capacity according to the forage available, irrespective of the stocking of the other pastures.

During the first winter, there was no significant difference in the number of worms found in steers of the three groups. However, the two rotationally grazed groups had more parasites than the continuously grazed group. In general, steers that year had fewer parasites than in previous years, which may account for the small difference in the groups.

During the second two winters, however, the overstocked Group III steers had significantly more worms than steers in Groups I and II.

Rotational grazing is still a good management practice, but cattlemen should be careful not to overstock pastures and thus negate the advantages of rotating pasture areas. ■

Field trials at Beltsville, Md., also indicate that overstocking pastures increases internal parasites in cattle. Cattle normally do not graze forage around droppings but will if forage is scarce. Parasites migrate from droppings to the surrounding grass, reinfecting cattle that eat this grass.

ARS parasitologist Aaron Goldberg studied the migration of parasites from cattle droppings during the summer. Peak recovery of larvae from feces occurred 1 to 2 weeks after deposition. Peak recovery of larvae from the grass occurred 2 to 4 weeks after deposition and some larvae survived as long as 5½ months. Of the larvae recovered in the study, 85 to 88 percent were within 13 centimeters of the feces.

for a full flower-pot

Cathey measures light level inside germination chamber. Light level is checked often, and fluorescent tubes are replaced if they begin to fade (1269A292–14).

A WEALTH of information on the effects of light and temperature on seed germination is now available for the professional nurseryman and home gardner, both of whom will find it of value.

For over 100 years, science has been aware of the influence of light and temperature on seed germination—but little more than aware until the last 20 years. The past two decades have seen great strides in unravelling the mechanisms of the light-growth relationships of plants, now called photoperiodism. The pigment that directs these relationships, for instance, was isolated in 1959 by ARS scientists, who called it phytochrome.

In a recent study, ARS horticulturist H. M. Cathey, motivated by seed germinating difficulties, applied the concepts of photoperiodism to a wide range of seeds. For the series of germination studies, Cathey used the seeds of 111 different kinds of commonly available annuals, pot plants, and herbs.

Cornflower seeds removed from chamber show seed response to continuous dark (left) and light (PN–1863).

Cathey turned up information both interesting and productive such as: temperature alone regulates the germination of 59 species including alyssum, aster, carnation, marigold, and zinnia; light is a necessary or helpful factor in germinating 27 fine-seeded species such as begonia, petunia, and snapdragon; and darkness is a necessity for the uniform germination of 25 species including cornflower, larkspur, pansy, and shamrock. This information will allow the ornamental grower to arrange his seeds in a logical way in the greenhouse.

In the future, Cathey plans to extend his germination investigations to include many more ornamentals in the perennial and woody families.

The results of the study lead to a logical question: How have plants managed to survive when some seeds demand such specific conditions to germinate? Part of the explanation lies in the fact that in nature only a small percentage of the seeds survive and germinate.

And Cathey further explains that originally the conditions for seed germination were probably far from this specific. But through breeding practices to provide ornamentals with more desirable characteristics such as larger or better quality flowers, very precise germination requirements were probably also inadvertently bred in. The seeds of the original species of many plants were unquestionably able to survive and germinate under a much greater variety of conditions than are the highly refined hybrids of today.

Such is the price of dwarf marigolds and double petunias. ■

AGRISEARCH NOTES

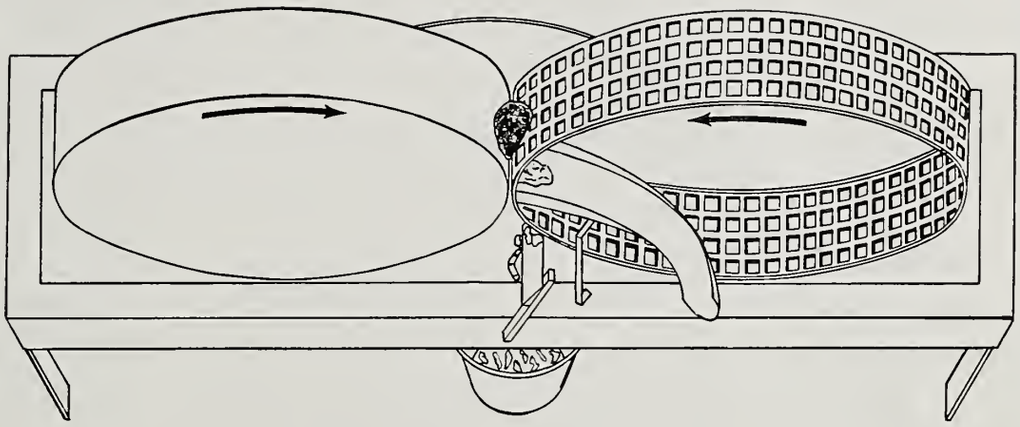
Squeezing the Peel Off Avocadoes

A new peeling machine may squeeze more avocadoes into frozen guacamole, an avocado product being marketed in many parts of the Nation.

The peeler is expected to aid in utilizing more than 2 million pounds of avocadoes discarded annually because of imperfections that make them undesirable for the fresh market. It was developed by food technologist T. S. Stephens at the ARS food crops utilization research laboratory, Weslaco, Texas.

The experimental machine consists of two drums, one with a solid surface and the other with a perforated surface, revolving toward each other. After seed removal, avocado halves are placed pulp side down on the perforated drum. As the fruit travels between the drums, the pulp is forced through the perforations while the skin passes on between the drums for discard.

Guacamole is mashed avocado flavored with small amounts of lemon, salt, and other condiments for use as a dip or salad. The frozen product is a result of ARS and industry research carried on over a number of years.



Simplified drawing from above of the experimental avocado peeler. Pulp is squeezed from halved avocado as drums revolve toward each other (PN–1864).

All-Roughage Diet for Cattle?

Finishing cattle *entirely* on roughage could become a reality should cattle compete more intensively with man for needed grains.

With this in mind, ARS nutritionist R. R. Oltjen fed cattle on an all-roughage diet in two trials at Beltsville, Md. The steers gained well on a pelleted, 98½-percent alfalfa hay ration. Steers were taken directly off pasture at 500 pounds and fed to a weight of 1,000 pounds.

In the first trial, control steers fed an all-concentrate diet gained 2.8 pounds per day while those fed a combination of concentrates and roughages gained only slightly more than the cattle fed all-roughage, which gained 2.3 pounds daily. In the second trial, Oltjen fed steers on roughage diets in which the alfalfa was diluted in varying amounts with timothy hay. Increasing the percentage of timothy hay in the diet decreased gains. The steers fed the all-timothy hay diet did not gain as well as steers on the all-alfalfa diet—1.85 vs. 2.13 pounds per day.

A plus for the alfalfa-fed steers is that they graded choice in both studies and a taste panel rated their meat equal to the concentrate-fed steers in flavor and juiciness.

Oltjen says feeding all-roughage may not be practical at this time when we are striving for fast gains. However, it is a future possibility.

Amino Acid Helps Prevent Anemia

The amino acid histidine may prove useful in treating iron-deficiency anemia, one of the most common and debilitating nutritional diseases in the world.

ARS biochemist Darrell Van Campen of the U.S. Plant, Soil, and Nutrition Laboratory at Ithaca, N.Y., found that adding histidine to iron solutions produced a fivefold increase in the amount of iron absorbed from intestinal segments of test rats.

In the experiments, segments of the intestine were tied off, and radioactive iron—with and without histidine—was placed inside. When histidine was placed into one segment and iron into the adjacent segment, no additional absorption was noted. Nor was there any additional absorption when histidine was injected at the same time that iron was placed into an intestinal segment. The histidine and iron, it seems, must be administered together if histidine is to have effect.

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Other preliminary work by Van Campen suggests that histidine can increase absorption of orally-administered ferric iron.

It is quite possible that histidine, which occurs as a normal byproduct of protein hydrolysis in the gastrointestinal tract, is involved in the normal absorption of iron. If so, then Van Campen's findings help explain the anemia that generally accompanies a low-protein diet. His findings may be useful in helping scientists develop new ways of improving the nutritional quality of human foods and animal feeds.

The results of Van Campen's studies also help explain why some people who eat a good diet with plenty of iron still have anemia; it's simply that their systems seem unable to absorb the iron they ingest.

New Treatment Checks Blackspot

Blackspot, perhaps the most prevalent and destructive disease of roses, has been curtailed for as long as 40 days with an experimental fungicide treatment.

In experiments by J. G. Palmer and Pete Semeniuk, ARS horticulturists, benomyl was the only systemic fungicide that markedly retarded development of symptoms. They applied captan, maneb, and benomyl to the soil of mature rose bushes of Pink Radiance, Red Radiance, and Nocturne. The bushes were then inoculated with the fungus at intervals up to 146 days.

Palmer and Semeniuk report that amounts up to ½ pound of the active ingredient benomyl per 25 square feet of soil under field conditions were the most effective concentrations. One pound per 25 square feet caused intraveinal yellowing of the leaves.

The horticulturists caution that since only the Maryland strain of Blackspot was present and since tests were made on only three rose varieties, further research on many varieties and under other environmental conditions should be undertaken.

The USDA has not registered benomyl for use on roses.

Gases Cause Milk Off-Flavor

A large percentage of off-flavors in cow's milk are caused by volatile substances carried with belched gases.

ARS physiologist R. W. Dougherty, Ames, Iowa, found that substances causing off-flavors are transported from the cow's rumen to the lungs with belched gases. In the lungs, the gases are absorbed into the bloodstream, causing a noticeable rise in blood gas levels. In the blood, the off-flavor-producing substances travel to the mammary gland and eventually appear in the milk. Off-flavors entering the milk via gases in the lungs reach the milk sooner than those which pass through the digestive system.

When a cow belches, Dougherty found that she absorbs over half of these belched gases, primarily methane and carbon dioxide, into her lungs. A 1,000-pound cow may belch as much as 2 liters of gas per minute.

To trace the movements of these gases, Dougherty placed in the rumen methane and carbon dioxide gases labeled with radioactive carbon-14. Subsequently, radioactivity was found in many parts of the body, including the milk.

The cows were then fed onions and leeks, which cause off-flavors in milk, and blood samples were taken to study the movements of the gases. When belched gases were prevented from entering the lungs, off-flavors occurred in the milk only after an interval of 90 minutes. When the same material was mixed with inspired air, off-flavors were detected in the milk in a few minutes. Onions must undergo some digestion by rumen bacteria before off-flavors are liberated; leeks require no bacterial digestion.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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